WHAT IS CLAIMED:

1. A method of polarization-independent optical sampling of an optical input signal in optical communications, comprising:

using a probe pulse source of a predetermined wavelength to obtain a probe pulse signal;

processing said optical input signal by using two polarized optical input signal components 'p' and 's' of the optical input signal with said probe pulse signal in an unsplit form, to combine said two polarized optical input signal components in first and second stages separately with said probe pulse signal, by converting in said first stage one of said two polarized input signal components to produce a first component of an output signal, and diverting said first component of said output signal into an optical measuring element;

phase shifting the other of said two polarized input signal components;

converting in said second stage said phase shifted input signal component to produce a second component of said output signal; and

diverting said second component of the said output signal also into said optical measuring element.

2. A method as in claim 1 including using sum frequency generation (SFG) operation for said steps of converting said polarized input signal components in said first and second stages, and wherein said optical input signal has a known frequency range and wherein said probe pulse signal has a frequency which is approximately a second harmonic frequency of said known frequency range and wherein said output signal is a near-third harmonic signal relative to said known frequency range.

3. A method as in Claim 2 wherein the step of processing includes using a dichroic splitter for polarizing the optical input signal into signal components 'p' and 's' and wherein said first stage comprises a first stage nonlinear conversion for converting 's' polarized input signal component to generate the first component of said near-third harmonic signal, and said second stage comprises a second stage nonlinear conversion for converting 'p' polarized input signal component to generate the second component of said near-third harmonic signal.

4. A method as in Claim 3 wherein the step of using said SFG operation comprises using periodically poled lithium niobate (PPLN) crystals for the first and second stages of conversion.

5. A method as in Claim 1 wherein said optical measuring element comprises one of a photomultiplier tube and an avalanche diode.

6. A method as in Claim 2 wherein said optical input signal is a signal of known fundamental frequency corresponding to a wavelength range of about 1560 nm, and wherein said near-third harmonic is nearly thrice in frequency and 1/3 in wavelength in relation to said known frequency of the optical input signal.

7. A method as in Claim 6 wherein said probe pulse signal is a converted probe pulse source frequency obtained by frequency-doubling a source which is in the range of about 1550 nm.

8. A method as in Claim 1 wherein the step of processing said optical input signal comprises bringing in the optical input signal for optical sampling via an optical fiber.

9. A method as in Claim 7 including the step of using an optical filter after frequency-doubling, to arrest any unconverted probe pulse source frequency.

10. A method as in Claim 2 including the step of using a blocking filter for preventing signal components of frequency other than the near-third harmonic from reaching said optical measuring element.

11. A method as in Claim 1 wherein the step of diverting comprises using a dichroic splitter.

12. Apparatus for performing polarizaton-independent optical sampling of an optical input signal in optical communications, comprising:

a probe pulse signal source of a known wavelength from which a probe pulse signal is obtained;

an arrangement to process said optical input signal by using two polarized components 'p' and 's' of said optical input signal in first and second stages, said arrangement including

a first stage to combine said probe pulse signal in an unsplit form with a first of said two polarized optical input signal components 'p' and 's', to generate a first component of an output signal;

a second stage to combine said probe signal in an unplit form with a second of said two said polarized optical optical input signal coponents to generate a second component of an output signal; and

an optical measuring element to combine and measure a sum of the first and second components of said output signal to procure an optical sample of said optical input signal.

13. Apparatus as in claim 12 wherein said first and second stages each comprise a sum frequency generation (SFG) operation and wherein said optical input signal has a known fundamental frequency range and wherein said probe pulse signal has a frequency which is approximately a second harmonic of said known frequency and wherein said output signal is a near-third harmonic frequency relative to said known frequency.

14. Apparatus as in Claim 12 wherein the optical input signal is of a known fundamental frequency and said probe pulse signal is substantially a second harmonic of said known fundamental frequency, wherein said first stage converts one of said two polarized input signal components by sum frequency generation (SFG) to produce a first component of a near-third harmonic signal with a frequency nearly thrice said fundamental frequency, said apparatus including a diverter for diverting said first component of the near-third harmonic signal into said optical measuring element.

15. Apparatus as in Claim 14 wherein said second stage converts the other of said two polarized input signal components by SFG to produce a second component of said near-third harmonic signal, said processing arrangement including a unit for directing the second component of the near third harmonic signal also into said optical measuring element.

16. Apparatus as in Claim 13 wherein said processing arrangement comprises first stage nonlinear conversion for converting said 's' polarized input signal component to generate the first component of said near third harmonic signal, and a second stage nonlinear conversion for converting said 'p' polarized input signal component to generate the second component of said near third harmonic signal.

17. Apparatus as in Claim 16 wherein the sum frequency generator comprises periodically poled lithium niobate (PPLN) crystals for the first and second stage nonlinear conversion.

18. Apparatus as in Claim 12 wherein said optical measuring element comprises one of a photomultiplier tube and an avalanche diode.

19. Apparatus as in Claim 13 wherein said known fundamental frequency range corresponds to a wavelength of said optical input signal.

20. Apparatus as in Claim 12 wherein said known wavelength of the probe pulse source corresponds to a frequency of 1550 nm, the apparatus including a frequency-doubler to perform frequency-doubling of the probe pulse source.

21. Apparatus as in Claim 20 wherein the user input signal has a wavelength in the range of 1560 nm, said apparatus including an optical filter located at an output of said frequency-doubler, to arrest any unconverted probe pulse source frequency.

22. Apparatus as in Claim 13 including a blocking filter for preventing signal components of frequency other than the near-third harmonic signal frequency from reaching said optical measuring element.

23. Apparatus as in Claim 12 including a mirror for use as a diverter for directing a first component of said output signal into said optical measuring element..

24. A method of polarization-independent optical sampling of an optical input signal in optical communications, comprising:

using a probe pulse source of a predetermined wavelength range, and frequency-doubling signals from said probe pulse source in an unsplit form to obtain a converted intermediate output containing a frequency-doubled second harmonic probe pulse signal;

processing said optical input signal by using two polarized signal components 'p' and 's' of said optical input signal;

said step of processing including:

causing a sum frequency generation (SFG) operation to combine said two polarized input signal components in first and second stages separately with said frequency-doubled unsplit second harmonic probe pulse signal, converting in said first stage one of said two polarized input signal components by SFG to produce a first component of a near-third harmonic output signal, and diverting said first component of the near-third harmonic output signal into an optical measuring element;

converting in said second stage the other of said two polarized input signal components by SFG to produce a second component of a near-third harmonic signal; and

directing the second component of the near-third harmonic signal also into said optical measuring element.

25. A method as in Claim 24 wherein said first stage comprises:

passing said optical input signal, in a nonpolarized form, along with said second harmonic probe pulse signal through a beam splitter, and then subjecting said one polarized component of the user's optical input signal and said second harmonic probe pulse signal to sum frequency generation (SFG) in a nonlinear wavelength conversion crystal for producing a first SFG signal, said first SFG signal containing said first near-third harmonic output signal;

passing said first SFG signal containing the first near-third harmonic output signal through an achromatic ¼ waveplate that is transparent to a predetermined wavelength range including said near-third harmonic output signal, said first SFG signal also containing (i) an unconverted second harmonic probe signal which gets rotated by 90° by the ¼ waveplate, and (ii) a second polarized component of the user's optical input signal which gets rotated by 45° by the ¼ waveplate;

passing the first SFG signal through a dichroic mirror that is transparent to only said first near-third harmonic output signal, said dichroic mirror reflecting and returning at least a portion of the second harmonic probe signal and said second polarized component of the user's optical input signal in a direction of said nonlinear wavelength conversion crystal through said ¼ waveplate;

said step of diverting comprising directing said first near-third harmonic signal into said optical measuring element with the use of a mirror;

allowing said reflected returned portion of the second harmonic probe signal and the second polarized component of the user's optical input signal to pass through said achromatic ¼ waveplate in a reverse direction thereby firstly causing said second polarized component of the user's optical input signal to rotate by a total of 90° because of twice passing through said achromatic ¼ waveplate, and secondly causing said second harmonic probe signal to rotate by 180° because of twice passing through said achromatic ¼ waveplate;

subjecting said 90° shifted second polarized component of the user's optical signal and said reflected 180° rotated returned portion of the second harmonic probe signal to SFG to obtain a second near-third harmonic signal by using said nonlinear wavelength crystal; and

reflecting said second near-third harmonic output signal by said beam splitter to said optical measuring element.

26. A method of nonpolarization-dependent optical sampling of an optical input signal of a known frequency in a first pass and a second pass, by using a sampling pulse that is of near second harmonic frequency relative to said known frequency, said optical input signal containing first and second polarization components, said method comprising, in said first pass, the steps of:

(a) performing sum frequency generation (SFG) of said first polarization component of the optical input signal and the sampling pulse in a nonlinear wavelength converter to obtain a first converted signal containing (i) a first near-third harmonic signal, (ii) unconverted sampling pulse and (iii) unconverted second polarization component of the optical input signal

(b) passing said first converted signal through a ¼ waveplate that lets through said first converted signal, but rotates said unconverted second polarization component by 45° and rotates said unconverted sampling pulse by 90°;

then passing said first converted signal through a dichroic mirror that is transparent to said first near-third harmonic signal, said dichroic mirror reflecting and sending back said rotated unconverted sampling pulse and rotated unconverted second polarization component of the user optical input signal towards said nonlinear wavelength converter;

(c) directing said first near-third harmonic signal to an optical measuring unit;

and, in said second pass;

(d) passing reflected rotated unconverted sampling pulse and said rotated unconverted second polarization component of the user optical signal through said ¼ waveplate to shift said unconverted second polarization component of the user optical signal by an additional 45°, to make a total shift of 90° and to shift said rotated unconverted sampling pulse by an additional 90° to make a total rotation of 180°;

(e) performing SFG on said 90° shifted unconverted second polarization component of the user signal by using said reflected 180° rotated unconverted sampling pulse to obtain a second near-third harmonic signal; and

(f.) sending said second near-third harmonic signal to said optical measuring unit.

27. Apparatus for nonpolarization-dependent optical sampling of a user optical signal of a known frequency by using a sampling pulse that is of near second harmonic frequency relative to said known frequency, comprising:

a beam splitter that is transparent to and located to let through said sampling pulse and user optical signal;

a nonlinear wave conversion element that is disposed to receive said sampling pulse and user optical signal to perform sum frequency generation (SFG) thereon to produce a first converted signal containing (i) a first near-third harmonic signal, (ii) unconverted sampling pulse and (iii) unconverted second polarization component of the user signal;

a ¼ waveplate disposed to let through said first converted signal where

(i) the second harmonic frequency sampling pulse gets rotated by 90°;

(ii) the unconverted second polarization component of the user signal gets rotated by 45°;

(iii) said first near-third harmonic signal passes through unchanged;

a dichroic mirror that is transparent to said near-third harmonic and disposed in a path of said first converted signal, said dichroic mirror reflecting said second harmonic frequency sampling pulse and said unconverted second polarization component back into said ¼ waveplate, causing said second harmonic frequency sampling pulse to be rotated by an additional 90° to cause a total rotation of 180°, and causing said unconverted second polarization component of the user signal to be rotated by an additional 45° to cause a total rotation of 90°; and

an optical measuring unit disposed to receive said first near-third harmonic signal;

said nonlinear wave conversion element performing a second sum frequency generation on said reflected 180° rotated second harmonic frequency sampling pulse and said 90° rotated unconverted second polarization component of the user signal to produce a second near-third harmonic signal; said beam splitter reflecting and diverting into said optical measuring unit said second near-third harmonic signal.

28. Apparatus as in claim 27 wherein said nonlinear wave conversion element comprises a periodically poled lithium niobate (PPLN) crystal of predetermined configuration, and including a heater to apply heat to the PPLN to minimize photorefractive damage.

29. Apparatus as in claim 27 wherein said known frequency of the user optical signal corresponds to a wavelength of 1550 nm and wherein said beam splitter is a dichroic beam splitter, said apparatus including at least one collimating lens, and an optical fiber and a lens arrangement through which said user optical signal is brought in for optical sampling.

30. Apparatus as in claim 27 including an optical filter located so as to screen frequencies other than said first and second near-third harmonic signals, and let through the first and second near-third harmonic signals for measurement by the optical measuring unit.

31. Apparatus as in claim 24 including a variable attenuator in a path of the first near-third harmonic signal, and a time dispersion compensator interposed between said nonlinear wave conversion element and said ¼ waveplate.

32. An apparatus for polarization-independent optical sampling of an optical input signal in optical communications, said optical input signal having two polarized components 'p' and 's', comprising:

a probe pulse source of a predetermined wavelength range;

a frequency doubler for frequency-doubling signals from said probe pulse source to obtain an intermediate output containing a frequency-doubled unsplit second harmonic probe pulse signal; and

a processing arrangement to process said optical input signal by using both polarized input signal components ‘p’ and ‘s’, said processing arrangement including:

a sum frequency generator for causing a sum frequency generation (SFG) operation to combine each of the two polarized input signal components ‘p’ and ‘s’ separately in first and second stages with said frequency-doubled unsplit second harmonic probe pulse signal.